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CHAPTER PRESIDENTS AND SECRETARIES

ALBANY—**Herbert L. Bryan,** *Director of Research and Stat., New York State Dept. of Correction, 39 Columbia Street, Albany, New York;* **Herman S. Solomon,** *40 Glenwood Street, Albany 8, New York.*

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CENTRAL NEW JERSEY—**Francis J. Anscombe,** *Fine Hall, Box 708, Princeton, New Jersey;* **Reuben Cohen,** *Opinion Research Corp., North Harrison Street, Research Park, Princeton, New Jersey.*

CHICAGO—**A. Arthur Charous,** *Sears Roebuck & Co., Dept. 733C, General Merchandise Office, Chicago, Illinois;* **Thomas D. Burke,** *The Chicago Tribune, 435 N. Michigan Avenue, Chicago 11, Illinois.*

CINCINNATI—**Gregory P. Williams,** *2725 Stratford Ave., Cincinnati 20, Ohio;* **Carl C. Smith,** *The Christ Hospital, Institute of Medical Research, Cincinnati 19, Ohio*

CLEVELAND—**David Frazier,** *Research Div., Standard Oil Company of Ohio, 2127 Cornell Road, Cleveland 6, Ohio;* **Charles H. Joseph, Jr.,** *American Greetings Corp., 1300 W. 78th Street, Cleveland, Ohio*

COLORADO-WYOMING—**Dennis Stump, Jr.,** *1205 S. Harrison Street, Denver 10, Colorado;* **Harriet E. Little,** *Blue Cross, Blue Shield Plans, 1653 Lawrence Street, Denver 2, Colorado*

COLUMBUS—**James C. Yocum,** *Bureau of Business Research, The Ohio State University, Columbus, Ohio;* **Mikhail V. Condoide,** *188 West 10th Avenue, Columbus 1, Ohio*

CONNECTICUT—**Colin White,** *81 Russell Street, Hamden, Connecticut;* **Royal A. Crystal,** *Manager, Statistical Dept., Connecticut Medical Service, Inc., P.O. Box 1930, New Haven, Connecticut*

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NEW YORK—**Douglas Greenwald,** *McGraw-Hill, 330 West 42nd Street New York 36, New York;* **Sidney Sameth,** *Union Health Center, 275 7th Avenue, New York, New York*

NORTH CAROLINA—**Gertrude M. Cox,** *Institute of Statistics, Box 5457, State College Station, Raleigh, North Carolina;* **Robert J. Monroe,** *Box 5457, State College Station, Raleigh, North Carolina*

NORTH TEXAS — **Paul D. Minton,** *Mathematics Dept., Southern Methodist University, Dallas, Texas;* **Miss Nellie Marie Barnes,** *6005 Hillcrest Avenue, Dallas 5, Texas*

OKLAHOMA CITY—**William Wells,** *Statistical Control Branch, Tinker Air Force Base, Midwest City, Oklahoma;* **Ellen L. Bryan,** *2505 Northwest 31st Street, Oklahoma City, Oklahoma*

PHILADELPHIA—**Benjamin J. Tepping,** *National Analysts, Inc., 1015 Chestnut St., Philadelphia 7, Pa.;* **Richard W. Glancy,** *The Bell Telephone Co. of Pa., 1835 Arch Street, Philadelphia 3, Pa.*

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PUERTO RICO—**Alvin Mayne,** *2169 Calle Gen Del Valle, Santurce, Puerto Rico;* **Amadeo Francis,** *Puerto Rico Economic Association, Santurce Building, 4th Floor, Santurce, Puerto Rico.*

ROCHESTER, N. Y.—**Robert O. Welk,** *Kodak Office Statistical Dept., Eastman Kodak Company, 343 State Street, Rochester 4, New York;* **Donald A. Wright,** *Paper Service Div., B-36, Kodak Park Works, Eastman Kodak Co., Rochester 4, New York.*

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SOUTHERN CALIFORNIA—**Alvord L. Boeck,** *Kwickset Locks, Inc., 516 E. Santa Ana St., Anaheim, California;* **Wm. V. Henderson,** *Pacific Telephone Co., Rm. 916, 740 So. Olive Street, Los Angeles 55, California.*

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WASHINGTON, D. C.—**Harold F. Dorn,** *National Institutes of Health, Bethesda, Md.;* **Edwin D. Goldfield,** *Chief, Statistical Reports Division, Bureau of The Census, Washington 25, D. C.*

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The Editorial Committee welcomes the submission of manuscripts for possible publication. Two copies, double-spaced, should be sent to the Editor, Morris Hamburg, E-230 Dietrich Hall, University of Pennsylvania, Philadelphia 4.

News and notes should be sent to Dana Barbour, News Editor, American Statistical Association, 1757 K Street, N.W., Washington 6, D. C.

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The President's Column

Walter E. Hoadley, Jr.

What Are We Accomplishing?

Article II of the Constitution of ASA states that, "The objectives of the American Statistical Association shall be to foster, in the broadest manner, statistics and its application, to promote unity and effectiveness of effort among all concerned with statistical problems, and to increase the contribution of statistics to human welfare." Many different methods and activities help us accomplish these important goals and I believe that the Association has made great strides, particularly in the years since the war. Some further progress has been made this year toward realization of these aims. This is not to say that all our problems have been solved—far from it!! Indeed, as the Association grows larger, some of the problems grow too. However, I think the Association can take pride in its accomplishments.

Certainly, the main problem receiving attention at the moment concerns our publications and both present and future policy for them. We are now exploring with the Committee on Publications Policy the immediate and the long-range aspects of our whole publications program. Many of you received the questionnaire formulated by the Committee and sent to a random sample of the membership. This questionnaire was designed to elicit information on how well our publications are meeting the needs of the membership. The returned forms are now in the process of being coded and tabulated. Every comment written on the questionnaires is being recorded for special analysis. We expect to report more fully on the results of this study early next year. It will be the main topic of discussion at the Board and Council meeting to be held in Chicago during the Annual Meeting.

One decision taken this year ". . . to foster . . . statistics and its application . . ." has been the establishment in cooperation with the American Society for Quality Control of the new journal, TECHNOMETRICS. While

(Continued on back cover)

NEWS

ASA ANNUAL MEETING — REPORT OF OCTOBER 8TH BOARD MEETING — MEETING OF (ENAR), IMS AND SPES — MEETING OF THE FEDERAL STATISTICS USERS' CONFERENCE — NSF FELLOWSHIPS — SUMMER SESSIONS — PUBLICATIONS — JOB OPENINGS

ASA Annual Meeting

Members planning to attend the 1958 Annual Meeting of the American Statistical Association to be held at the Congress Hotel in Chicago, December 27-30 should remember to register in advance in order to avoid delay. Pre-registration forms have been sent to members and these should be returned with the $2.00 registration fee. If you want extra copies of the forms, please write to Mr. George Cloos, Federal Reserve Bank of Chicago, 230 S. LaSalle St., Chicago 4, Ill. One registration covers attendance at sessions of the ASA and the other Social Science Associations meeting at the same time. These include the American Economic Association, the American Farm Economic Association, the Catholic Economic Association, the American Finance Association, the Econometric Society, the American Marketing Association, the American Association of University Teachers of Insurance, and the Industrial Relations Research Association. The Biometric Society (ENAR) will be at the Congress Hotel with ASA.

Sessions have been planned by the Business and Economic Statistics, Training, Social Statistics, Physical and Engineering Sciences, and Biometric Sections of the ASA. In addition several meetings with especially broad interest coverage, including the economic outlook luncheon on December 28 and President Walter E. Hoadley's address on December 29, have been scheduled. The informal reception will also be held on Monday, December 29. The complete advance program of the meeting appeared in the October issue of THE AMERICAN STATISTICIAN.

An employment register, operated by the Illinois State Employment Service, affiliated with the U. S. Employment Service, will be available at the meeting to serve members who are seeking employment and those who desire to recruit qualified personnel.

Board Meeting of October 8th

The Board of Directors of the American Statistical Association met at the Cosmos Club in Washington, D. C. on October 8th. Those present included ASA President Walter E. Hoadley, Jr.; Directors Ralph E. Burgess, Lester R. Frankel, H. O. Hartley and Geoffrey Moore; Donald C. Riley, Secretary-Treasurer; Dudley Kirk, Chairman of the Social Statistics Section; Morris Hamburg, Editor, THE AMERICAN STATISTICIAN; Almarin Phillips, Chairman, Committee on Publications Policy; and Edgar M. Bisgyer, Office Manager of the ASA.

Mr. Kirk presented a formal request to the Board for the publication of a volume containing the papers in the sessions to be presented by the Social Statistics Section at the Annual Meeting in Chicago this December. The Association would assume responsibility for the costs of such publication, insofar as they were not covered by sales. The format would be similar to that used for the Proceedings of the Business and Economic Statistics Section. The undertaking would be regarded as an experiment to be repeated in 1959 at the discretion of the ASA Council and the officers of the Social Statistics Section. The Board voted to recommend approval of such a volume to the Council. The motion will be submitted to the Committee on Publications Policy, asking for its views, prior to sending the mail ballot to the Council for final approval.*

Some time was devoted to a discussion of the proposed new journal devoted to statistics in the physical and engineering sciences, which was first mentioned in the President's Column of the October 1958 issue of THE AMERICAN STATISTICIAN. This journal, to be called TECHNOMETRICS, is being sponsored jointly by the American Statistical Association and the American Society for Quality Control. It is expected that Dr. J. Stuart Hunter of Princeton University will be the editor. There will be a management committee composed of representatives of the two societies, but details of organization have not yet been worked out.

A progress report was made on the publications policy questionnaire. This questionnaire, which had been sent to a random sample of 1,769 members of ASA in early September, had been returned by about 50 per cent on October 1. On October 6th and 7th a follow-up request was sent to those who did not return a completed questionnaire. Earl Houseman of the Department of Agriculture, who designed the sample, is assisting the Publications Policy Committee in tabulating and analyzing the returns. It is expected that the results will be available for study by the Board and Council at their meeting in December.

The Program Committee reported that a total of 52 sessions has been programmed for the Annual Meeting in December, and that its work is nearly complete except for supervision of the preparation and collection of abstracts of papers to be presented at the meeting.

* ED. NOTE: Since the date of the Board Meeting, a majority of the members of the Council have approved publication of the proceedings of the Social Statistics Section.

Interim reports were received from other committees of the Association.

The Secretary-Treasurer presented an Interim Statement of Financial Condition as of September 30, 1958, and a Comparative Budget Statement showing income and expense. On the basis of projected totals for 1958 it appears that there will be a surplus of about $3,400 for the year. This is in contrast to expectations of a deficit, and is due principally to two factors—an increase in income resulting from an increase in membership larger than expected, and smaller issues of the JOURNAL for September and December than anticipated. However, it was pointed out that costs continue to rise and new membership dues and other income may not be sufficient in the future to maintain a balanced budget.

The Board approved the request of the Denver Chapter for a change of name to the Colorado-Wyoming Chapter.

Joint Meeting of Biometric Society (ENAR), IMS and SPES

The Spring Meeting of the Biometric Society, Eastern North American Region, the Institute of Mathematical Statistics, and the Section on Physical and Engineering Sciences of the American Statistical Association will be held at the University of Pittsburgh, March 19 to 21. Boyd Harshbarger, Department of Statistics, Virginia Polytechnic Institute, Blacksburg, Virginia, is in charge of the IMS part of the program; Edmund Gehan, National Cancer Institute, Bethesda, Maryland, is arranging the Biometric part of the program; and Irving W. Burr, Purdue University, Lafayette, Indiana, is in charge of the SPES part of the program. Further information about the meeting will be reported in the February issue of THE AMERICAN STATISTICIAN.

Titles and abstracts of papers to be contributed at this meeting should be submitted in triplicate to the appropriate person noted above, depending on the subject-matter of the paper, no later than February 15, 1959.

Annual Meeting of the Federal Statistics Users' Conference

The Federal Statistics Users' Conference held its Second Annual Meeting on September 24 and 25 at the Hotel Statler in Washington. The Conference, whose members include business, farm, labor, and nonprofit research organizations having a common interest in the improvement of Federal statistics, was organized in 1956. The meeting was attended by 80 nongovernmental users of Federal statistics and more than 40 Government participants.

Two luncheon sessions and six round table discussions highlighted the meeting. Ewan Clague, Commissioner of Labor Statistics, spoke on "Statistics for Economic Policy," at the luncheon session on September 24. "A Businessman Looks at Federal Statistics" was the topic of an address by James C. Worthy, Vice President, Sears Roebuck and Company at the luncheon on September 25.

While pointing out that our "substantial arsenal of statistics" provided considerable help to policy makers dealing with the recession, Mr. Clague argued that Federal data are not fully adequate for dealing with many fundamental problems. Among other examples, he cited the need for better information on the relationships among labor costs, profits and other nonlabor costs, productivity, and prices in order to better understand the causes of inflation and the need for improved employment data in order to better answer questions relating to the characteristics and disposition of our labor force. Mr. Clague declared that small additional investments in improving statistical information would pay large future dividends by providing a better basis for making the decisions necessary to keep our complex economy operating smoothly.

Mr. Worthy's conclusions were substantially the same. Looking at Federal statistics as a business user, he declared that the decisions of large business organizations, such as Sears Roebuck, have far-reaching effects on the economy and need to be supported by the best possible information. Maintaining that Federal statistics have failed to keep pace with the needs of a growing, changing economy, he argued that users themselves are to blame for the lack of progress because they have not made clear their needs. Describing better Federal statistics as an investment in free enterprise, he said:

"I recognize, furthermore, that it is not exactly in character for a businessman to be arguing for higher government spending. But there is spending and there is spending. Certain kinds of spending are in the nature of investments and return far more than their cost. I would classify judicious expenditures on a more adequate statistical program as a prudent investment in the American system of free economic institutions."

The round table discussions in which both users and Government representatives participated were: "What Lies Ahead? Can We Expect Better Statistical Aids to Forecasters?," chaired by Ralph Watkins, Brookings Institution; "Productivity Statistics: Problems and Prospects," chaired by John W. Kendrick, George Washington University; "Better Construction Statistics: What Can We Do to Get Them?" with Joseph Hazen, Executive Editor, Architectural Forum, in the chair; "Geographic Detail in Federal Statistics: How Far Should We Go?" chaired by H. P. Alspaugh, Standard Rate and Data Service; "Outside Our Door: The Statistical Needs of Users with International Interests," with Alan C. Root of International General Electric as chairman; and "The Soft Goods Industries: Are Our Statistics Adequate?" with Solomon Barkin, Textile Workers Union of America, as chairman.

A number of nonprofit research organizations have joined the Conference since the establishment of its tax exempt status. Gerhard Colm, National Planning Association; Ingrid Kildegaard, Advertising Research Foun-

dation; Howard Stier, American Marketing Association; Herbert Stein, Committe for Economic Development; and Ralph Watkins, Brookings Institution, were elected trustees for the nonprofit group.

H. P. Alspaugh, Standard Rate and Data Service, and Robert J. Eggert, Ford Motor Company (reelected) were elected as business trustees.

Charles Donahue, United Association of Journeymen and Apprentices of the Plumbing and Pipe-Fitting Industry, and Nat Weinberg, United Auto Workers were reelected as labor trustees.

At a subsequent meeting of the Board of Trustees on October 3, Ralph Watkins, Brookings Institution, was elected Chairman, and Vincent Perry, General Foods Corporation; John Baker, National Farmers Union; and Peter Henle, AFL-CIO, were elected Vice Chairmen of the Conference. Ralph L. Gillen, McKinsey and Company, was named Secretary-Treasurer of the Conference.

National Science Foundation Fellowships for 1959-1960

The National Academy of Sciences-National Research Council will again assist the National Science Foundation with its eighth regular predoctoral and postdoctoral fellowship programs. The Foundation plans to award approximately 1,000 graduate and 200 postdoctoral fellowships in these two programs for scientific study during the 1959-1960 academic year. These fellowships are open only to citizens of the United States and are awarded solely on the basis of ability. They are being offered in the mathematical, physical, medical, biological, and engineering sciences, including anthropology and psychology: and from the following social sciences: geography, mathematical economics, econometrics, demography, information and communication theory, experimental and quantitative sociology and the history and philosophy of science. Also included are interdisciplinary fields which are comprised of overlapping fields among two or more sciences.

Michigan Summer Session In Health Statistics

The University of Michigan Graduate School of Public Health has again been selected as the host institution by the Accredited Schools of Public Health for the second cooperative summer training program in statistics applied to the health sciences. The program, which was very successful in 1958, is made possible by a research training grant from the Division of Research Grants of the National Institutes of Health, U. S. Public Health Service.

The purpose of the program, which will be given June 19 through August 1, 1959, is to present courses in health statistics on several levels of graduate study. The tentative list of courses is as follows: Statistical Methods in Public Health, Management of Health Agency Records, Registration and Vital Statistics, Biostatistics in the Health Sciences, Demographic Methods in Public Health, Statistical Methods in Epidemiology, Sampling Techniques in the Health Sciences, Advanced Biostatistics in the Health Sciences, and Statistical Methods in Biological Assay. There will also be a series of special lectures on topics of interest. Courses may be audited or taken for advanced credit. The faculty will be drawn from schools of public health and from the ranks of leading workers in the field of statistics in the health sciences.

Further information about the program may be obtained from Dr. F. M. Hemphill, Director, Summer Program on Statistics in the Health Sciences, School of Public Health, University of Michigan, Ann Arbor, Michigan.

Summer Offerings in Statistics at Iowa State College

The Department of Statistics at Iowa State College will offer six applied courses in statistical theory and methods in its two 1959 summer sessions. These courses are planned primarily for graduate students or research workers with limited mathematical backgrounds who wish to use statistical techniques intelligently for application to other fields. In addition, a course on special topics in theoretical or applied statistics may be studied at the graduate level. Senior staff members will be available during most of the summer for consultations on research or special problems.

Students may register for either or both of the six-week summer sessions: June 8-July 15 and July 15-August 21. The complete list of statistics offerings for the first session is as follows: Stat. 401, "Statistical Methods for Research Workers" (at the level of Snedecor's *Statistical Methods*); Stat. 447, "Statistical Theory for Research Workers" (mainly theory of experimental statistics at the level of Anderson and Bancroft's "*Statistical Theory in Research*"); Stat. 599, "Special Topics"; and Stat. 699, "Research." In the second session will be offered Stat. 402, a continuation of 401; Stat. 448, a continuation of 447; two courses in applied methods which are more specialized—Stat. 411, "Experimental Designs for Research Workers," and Stat. 421, "Survey Designs for Research Workers;" and finally Stat. 599 and 699. Additional information may be obtained from T. A. Bancroft, department head and Director, Statistical Laboratory, Iowa State College.

Establishment of Computing Center at U. of Kentucky

The University of Kentucky established in September a Computing Center with an IBM 650 and peripheral equipment at the University in Lexington, Kentucky for research and educational uses under the IBM educational contribution program. Dr. John W. Hamblen, formerly

Associate Professor of Mathematics and Director of the Computing Center at Oklahoma State University, has been employed as full time Director of the Computing Center which was established under the general supervision of the Office of the Vice President. An Advisory Committee has been appointed, composed of several deans and heads of departments with Dr. Leo M. Chamberlain, Vice President, as chairman.

Publication of Proceedings

The papers in the sessions presented by the Business and Economic Statistics Section at the forthcoming Annual Meeting in December, will be published early next year as a proceedings volume. This is the fourth consecutive year that a proceedings volume for this Section has been issued.

This year, a proceedings volume will also be published for the papers presented by the Social Statistics Section at the Annual Meeting (see news note on "Board Meeting of October 8"). Authors are urged, if they have not already done so, to send a copy of their abstract and the complete copy of their paper to the office of the Association, 1757 K Street, N. W., Washington 6, D. C. This will be used by the Publicity Committee in Chicago.

California Statistical Abstract

The first issue of the "California Statistical Abstract," slated for release this fall, is designed to bring together in one publication principal facts about California and to indicate sources of additional information. Patterned after the "Statistical Abstract of the United States," and covering nearly the same subjects, the "California Statistical Abstract" provides a wealth of current and historical information on the people, government, resources and economy of the State of California. It is organized in 24 sections with more than 240 tables. Each section contains an explanation of the terms used and gives sources of data.

The Abstract has been compiled by the State Interdepartmental Research Coordinating Committee and is sponsored by the California Senate's Fact-Finding Committee on Commerce and Economic Development.

Orders for the "California Statistical Abstract" should be sent to the Documents Section, Printing Division, Sacramento, California. The price is $3.50 to which California residents should add a 14 cent sales tax.

Revision of Bibliography of Nonparametric Statistics

A revision is being made of the "Bibliography of Nonparametric Statistics and Related Topics" contained in the December 1953 issue of the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION (Vol. 48, pp. 844-906).

Material through 1959 is to be included with more emphasis, it is hoped, on applications than previously. References (particularly to the non-English literature), reprints, and technical reports on the theory or applications of nonparametric statistics would be greatly appreciated. Also, corrections and additions to the original bibliography are desired. These should be sent to: Professor I. Richard Savage, Statistics Department, University of Minnesota, Minneapolis, Minnesota.

Random Balance Experiment Design

By permission of Dr. F. E. Satterthwaite, notes taken during a course on "Random Assignment Experimental Design," given by him on December 12-16, 1955, have been duplicated. While they are an exposition for the benefit of engineers planning to use the method, they represent a careful and authoritative statement of "how, when, and why to use random balance." They will be sent on request, as long as they last (200 copies). Please enclose 25 cents to cover the cost of postage and envelopes. Address your request to:

Eugene W. Pike
10 Churchill Lane
Lexington, Massachusetts

Institute of Management Sciences Meets

The Fifth Annual International Meeting of the Institute of Management Sciences was held in Philadelphia on October 16 to 18. The program included: recent developments in decision and network models; accounting and value theory; simulation methods; queueing theory and systems engineering; resource allocation models; programming, games, decisions and strategies; recent developments in programming; and simulation and automata.

Job Openings

The U. S. Army Chemical Center and Chemical Corps Materiel Command, Army Chemical Center, Maryland has a vacancy for Mathematical Statistician, GS-1530-11, $7510 per annum; and three vacancies for Analytical Statistician (Engineering), GS-1530-7, $4980 per annum; GS-1530-9, $5985 per annum; and GS-1530-11, $7030 per annum. Interested persons should write to Mr. John P. Bauernschub, Chief, Employee Utilization Branch, Civilian Personnel Division, Army Chemical Center, Maryland.

The U. S. Army Enlisted Evaluation Center, Fort Benjamin Harrison, Indiana has two positions open for Analytical Statisticians (Education). One position is GS-11 ($7,030) and the other is GS-12 ($8,330). A college degree and professional experience are required. There are good opportunities for advancement and further graduate study.

Applicants should forward a completed form 57 (obtainable at any post office) to:

Board of U. S. Civil Service Examiners
Finance Center, U. S. Army
Indianapolis 49, Indiana

International STATISTICAL ACTIVITIES

These pages, devoted to news of international statistical activities, form a new section inaugurated in this issue of THE AMERICAN STATISTICIAN. The proposal to include this section was made by Dr. Ernest Rubin of the Department of Commerce, upon his return from a recent European trip. Dr. Rubin has participated actively in planning the arrangements for obtaining communications for the section.

The cooperation of national statistical societies has been invited by Professor Morris Hamburg, Editor of THE AMERICAN STATISTICIAN who wrote (in part) as follows:

"It is our hope and desire that such a section will promote the interests of the international community of statisticians and further closer contacts among statisticians everywhere.

"In developing and maintaining such a section we wish to elicit your cooperation and assistance. If you would send us brief occasional notes pertaining to significant statistical news occurring in your country, we would incorporate your material in this section, consistent with space allocation, giving appropriate credit to the source.

"The following are suggested categories or areas of interest: new course programs; newly published books or studies in progress in the statistical field; newsworthy applications of statistical methods; news of specially invited papers or lectures before learned societies. This list is not intended to be exhaustive."

The favorable response to this letter has been most gratifying. The Inter American Statistical Institute, and correspondents in the Netherlands, Sweden, and the United Kingdom have already replied at this writing. In some cases, arrangements have been made for the ASA to receive national statistical news publications or other regular news notices. The ASA already receives a number of statistical journals which contain "News and Notes" sections similar to that of this journal.

Communications should be addressed to:

Dr. Joan Raup Rosenblatt
Editor, International Statistical Activities
American Statistical Association
1757 K Street, N.W.
Washington 6, D.C.

EUROPEAN ORGANIZATION FOR QUALITY CONTROL

The annual meeting of the EOQC was held this year at Essen (West Germany), September 10-12, 1958. The theme of the conference was "Consumer-Vendor Relations." Arrangements for the session were made by the Deutsches Arbeitsgemeinschaft für statistische qualitätskontrolle.

Further informations is available from the Secretariat of the EOQC, Weena 700, Rotterdam.

—*Statistisch Nieuws*
The Hague

—*Allgemeine Statistisches Archiv*
Munich

FRANCE

Tableau economique, 1758-1958. L'Institut National d'Etudes Demographiques (I.N.E.D.) is celebarting the bicentenary of the *Tableau économique* of François Quesnay, recognized as "founder" of systematic and mathematical political economy. The I.N.E.D. is publishing a new edition of the works of Quesnay on economics and philosophy, with commentaries, critical articles, and biographical and bibliographical studies. The new edition, entitled *François Quesnay et la physiocratie*, comprises two volumes. The first contains the articles and reference materials; the second volume contains a more complete and representative selection of the economic and philosophic work of Quesnay than any previously published (The Daire and Oncken editions appeared respectively in 1846 and 1888).

Contributors to the first volume include: **L. Einaudi,** former President of the Italian Republic, writing the preface and an historical note; **A. Sauvy,** Director of the I.N.E.D., contributing an introduction which relates the Tableau to modern systems of national accounting. The preface and introduction are followed by ten critical articles which treat Quesnay in his many aspects; demographer, economist, philosopher, and physician. The authors are: in demography, A. Landry and J. Conan; in economics, J. J. Spengler, J. Molinier, J. Benard, L. Salleron, and H. Woog; in philosophy, A. Kubota; and in medicine, Dr. Sutter. The commentary, notes, and index in volume two have been prepared by L. Salleron.

—*Population*
Paris

There has recently been formed the **Association francaise de Calcul numerique,** which is publishing a journal, *Chiffres* (Volume One, 1958). The address of the society is 98 bis boulevard Arago, Paris (XIV°).

POLAND

Dr. Ernest Rubin visited Poland as Chief of the U.S. Trade Mission, remaining in Poland from May 3 to July 3, 1958. During his visit he had various opportunities to meet economists and statisticians, and he has contributed the following notes.

"The Polish economists and statisticians follow developments in these fields in the U.S. with very great interest. Poland is, however, extremely short of journals and books in every professional field. The lack of funds (dollar exchange) is a great difficulty for Poland vis-a-vis imports from the U. S. During my visit, I arranged for the exchange of publications with the Polish Economic Society.

"Readers of this journal will be interested in a recent publication by Professor Oscar Lange, who before World War II was at the University of Chicago, and who after the war returned to Poland. (Today Professor Lange

(Continued on page 18)

FEDERAL STATISTICAL ACTIVITIES

Special Census Report on Company Statistics

A statistical report for companies, as distinguished from establishments, has been published by the Bureau of the Census as a special bulletin (Bulletin CS-1) of the 1954 Censuses of Business, Manufactures, and Mineral Industries. This report organizes the basic statistics collected in these censuses for establishments into company groupings. Each company includes all establishments under common ownership or control, and industry and size codes are assigned to the company as a whole.

The principal contribution of the report is that it relates statistics for companies and statistics for establishments. These relations are shown principally in the tables on industrial diversification. These tables show the extent to which companies, classified in 122 industrial groupings, spread their activities among different industries. They also show the extent to which establishments classified in a given industry are owned or controlled by companies primarily engaged in other industrial activities.

Additional tables published in this report show a distribution of companies with more than one establishment engaged in one ("single-industry") and more than one ("multi-industry") industrial activity. The employment of "single-industry" and "multi-industry" companies is also shown for each of the 122 industrial groupings developed for this report. A summary table shows a size distribution of multi-unit companies for the five main economic divisions covered by the censuses, and a supplemental table, separately available, shows such distributions for each of the 122 industry groups. In another table data are presented on both an establishment and company basis for the 122 industry groupings, with a reconciliation of the statistics compiled on the two different bases. The data include number of establishments; number of companies; payrolls; employment; value added and capital expenditures for manufacturing and mining industries; and sales for nonmanufacturing industries.

In addition to the tables presented in this report, supplemental and more detailed tabulations have been prepared (but not published) for each of the 122 industrial categories. A description of these supplemental tables appears in the report. There are no plans at present for publishing this additional detail, but special arrangements to examine it in Washington can be made with the Bureau of the Census.

Plans for the 1958 Censuses of Business, Manufactures, and Mineral Industries provide for publishing 1958 company statistics similar to those published for 1954. Further efforts will also be made to provide data relating financial statistics from balance sheet and profit-and-loss statements to establishment statistics on employment and value added.

Copies of Bulletin CS-1, "Company Statistics: 1954 Censuses of Business, Manufactures, and Mineral Industries," may be purchased at 60 cents each from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

—Julius Shiskin,
Chief Economic Statistician,
Bureau of the Census

Advisory Committee of Users of Educational Statistics

The new Advisory Committee of Users of Educational Statistics, appointed by the U. S. Commissioner of Education, had its first meeting in Washington on November 3, 1958. The Committee is composed of 14 persons representing the interests in educational statistics of public school systems (State and local), institutions of higher education, foundations, business and labor, libraries, and government agencies. Establishment of this committee follows a recommendation of a recent ad hoc Advisory Committee on Educational Statistics.

The membership of the new Advisory Committee of Users of Educational Statistics is as follows: James E. Allen, Jr., Commissioner of Education, New York State Education Department; John D. Conners, Director of Education Department, AFL-CIO; Francis G. Cornell, Englehardt, Englehardt, Leggett and Cornell; Roy K. Eden, Chief, Research and Statistics, Illinois State Board for Vocational Education; Martin W. Essex, Superintendent of Schools, Akron, Ohio; George Fern, Director of Education, National Association of Manufacturers; Frank W. Hubbard, Assistant Executive Secretary for Information Service, National Education Association; Howard Impecoven, Registrar, Portland State College; Thomas J. Mills, Program Director for Scientific Manpower, National Science Foundation; Charles A. Quattlebaum, Principal Specialist in Education, Legislative Reference Service, Library of Congress; John Dale Russell, Director of Institutional Research, New York University; Maurice Seay, Director, Division of Education, W. K. Kellogg Foundation; Jesse H. Shera, Dean, School of Library Science, Western Reserve University; Sidney G. Tickton, Manager, Technical Services, The Seventh Company, Inc.

In his letter of invitation, the Commissioner stated that the Committee "will be asked to review the statistical program of the Office of Education in general and in whatever detail it may deem desirable. Taking into consideration the major current problems in education, the Committee would give advice and make recommenda-

tions on the needs for statistics of education, the use to which they are and may be put, and on methods of enhancing their usefulness. The Committee in its discussions will undoubtedly wish to consider and advise on the priority of needs for statistics, accuracy and scope most desirable in particular cases, timing, and burden upon respondents."

At its first meeting, the Committee decided to begin its task with a study of Office of Education statistical projects in the field of higher education. Dr. Francis G. Cornell was elected chairman.

—Joseph W. Kappel, Assistant Director
Research and Statistical Services Branch
Office of Education

Among Recent Publications—

Report on Junior-Year Students in Science and Mathematics, (Circular 520), issued by the Office of Education, Department of Health, Education and Welfare. Results of first annual survey of junior-year college students majoring in science and mathematics. Principal objective is to provide data for estimating the number of degrees to be conferred two years in advance. Survey shows approximately 50,500 junior-year students, representing 13 percent of the total junior-year enrollment, were majoring in science or mathematics in November 1957. On this basis between 40,000 and 45,000 bachelors' degrees in science and mathematics are estimated for 1958-59 as compared with 33,800 such degrees in 1956-57. Available at 45 cents per copy from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Passenger Travel Survey-1957, issued by the Bureau of the Census, Department of Commerce. Report of results for the full 12-month period covered by the survey. A sub-sample of about 2,000 households in the Current Population Survey was interviewed each month during the year to obtain information regarding the total number of trips and trip-days, classified by reason for trip, means of transport, length of trip, labor status of traveler, family income level, age, origin and destination areas, and other related factors. In addition the report presents some preliminary information on the magnitude and nature of memory bias in obtaining information on travel based on recall over short time periods. Available at 25 cents per copy from the Bureau of the Census, Washington 25, D. C.

New Housing and its Materials, 1940-56 (BLS Bulletin No. 1231). Report of the Bureau of Labor Statistics based on interviews with builders of a sample of dwelling units under construction conducted in 1954, 1955 and 1956, together with data from earlier surveys published by the Housing and Home Finance Agency. The analyses of single-family houses presents and interprets nation-wide trends in the general plan and size of new houses, the materials used in their construction, and the equipment involved. The houses built in 1954-56 are studied intensively, comparing their structural and other characteristics in terms of their selling prices and the part of the country and type of area in which they were built. For the new multi-family dwelling units, classified into 2- to 4-family buildings and 5-or more family apartment houses, the information is presented only for the country as a whole. Available at 40 cents per copy from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

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THE STATISTICAL METHOD AND THE PHILOSOPHY OF SCIENCE*

Harold Hotelling, ***University of North Carolina***

Most people are aware of the theory of statistics primarily because of one or a few of its many applications. Not so well known are the effects on some very fundamental ideas and some very old disciplines of the intensive studies that have gone into making the theory of statistics what it is today, and which are still continuing. The subject shares with mathematics, and indeed in varying degrees with other disciplines, a feature on which Bertrand Russell once in effect remarked: Starting from the more familiar parts, one has a choice of going forward to the technical developments and applications, or of going backward to examine the logical and philosophical foundations. The first of these choices is the more popular. Russell of course followed the second in the case of mathematics. Our Principia Statistica is neither so voluminous nor so well worked out as the Principia Mathematica, but a glance at a few scattered pages of this uncollected but moderately well articulated body of knowledge, which is too new to be embraced in any one book, will serve to indicate some of the repercussions it is bound to have on the philosophical disciplines, so old yet still evolving, of metaphysics, epistemology, and especially inductive logic.

Mathematical statisticians, as many of them will be surprised to learn, are philosophers. They are philosophers, not merely in the jocose popular sense in which everyone who thinks even a little and talks a great deal is a philosopher, nor only in the etymological sense of a lover of wisdom, but in a precise sense sanctioned by high and serious authority. Indeed, two of the most ancient and central areas of philosophy are metaphysics and epistemology. Epistemology is the theory of knowledge, and statistical theory has long been concerned with measuring the amount of information and the strength of inferences obtainable from observations. From the big Webster dictionary we learn that metaphysics, which has elsewhere been characterized as the heart of philosophy, became after Descartes the science of the conditions of knowledge, and that

> Schopenhauer and later writers have insisted that metaphysics is concerned with the analysis of experience, in the broad sense, and this empirical view is largely held by modern writers.

The "conditions of knowledge" have been greatly clarified by the investigations of mathematical statisticians headed by Sir Ronald Fisher into the conditions of validity of experiments, and in "the analysis of experience" mathematical statisticians have provided not only such important special techniques as the analysis of variance but a great deal of far more general theory as well. Moreover, some mathematical statisticians are today actively at work developing further the general theory as well as special techniques.

Probability and Credibility

One fundamental problem is to sort out and clarify the different concepts that have passed under the name "probability," and to get rid systematically of the ambiguities and the widespread fallacies that have sprung from them. There are two main classes of concepts here, whose distinctness from each other has in this century been argued eloquently by Keynes and carefully by Carnap. These are called by Carnap Probability$_1$ and Probability$_2$. I do not however think that the accumulated fallacies of centuries can effectively be purged away by subscripts. It seems to me that entirely different words are needed, and I propose "Credibility" for the relation of hypothesis to uncertain conclusion, while reserving "Probability" for the numbers to which frequency ratios of some kinds of repetitive events appear to converge. These have sometimes been distinguished as "subjective" and "objective" probability, with the sobriquet "physical" occasionally replacing "objective." But Keynes argues forcefully in the earlier portions of *A Treatise on Probability* that "subjective" probability really has an objective content, though seldom measurable numerically, and that it alone should be dignified by the name which I now propose to take away from it. Keynes at this stage had a poor opinion of objective probability, and seemed to plead that, like Napoleon, it be consigned to an extremely limited domain. Statisticians, on the other hand, have seldom thought of objective probability as a King of Elba, but tend rather to regard it as the potentate of a spreading empire. As Keynes went on with the book, which was begun in 1911 and published in 1921, he undertook to propound a constructive theory of statistical inference, but was unable to do so. This failure was due in part to his long neglect of objective probability, which at the end of the book he reluctantly admitted might have some importance after all.

A credibility may be likened grammatically to a relation below the level of certainty between a protasis, or "if" clause, and an apodasis, or "then" clause. Order relations can be established among some credibilities, but these cannot be extended to cover all credibilities together, and meaningful numerical measures of the strength of credibilities cannot generally be obtained. Keynes suggests a partial ordering represented by a net-

* Presidential address to the University of North Carolina Chapter of Sigma Xi May 16, 1958.

work with many interconnections, rather than a single line, and writes of sweeping unidirectionally along the network from 0, representing impossibility, to 1 representing certainty. Yet it is easily demonstrable that even a network ordering is inadequate to represent all credibilities, whose transfinite cardinal number is greater than that of the continuum. It is tempting to try to construct a system of axioms for credibilities, and something of a start has been made, but no adequately categorical set is known. One obvious property is that when something is added to the apodasis, i.e., the conclusion, the credibility is not strengthened, but if changed at all, is weakened. Thus the credibility of the proposition "If I drive to Asheville I shall see a cow from the car window" is weakened if the word "red" is inserted before "cow," and becomes weaker still if a tailless red cow is specified. The correctness of the ordering attained in this way does not depend on any enumeration of cows or of such events. Some other such axioms can be formulated, but there are not enough of them to provide a complete ordering, much less a numerical measure, of credibilities in general.

From the standpoint of modern pure mathematics, probability is anything that satisfies a set of axioms such as the six that Kolmogoroff published in 1933, and is to be dealt with on the basis of measure theory in abstract spaces, always regarding probabilities as numbers. Accurate calculations of such probabilities in accordance with fixed, known rules possess mathematical consistency, but cannot by any purely mathematical argument be identified even approximately with the frequency ratio of outcomes of a particular type in a long series of trials. Such an identification is essential for every practical purpose, but cannot be established by pure mathematics in any specific case without the aid of adequate observations.

Probability, it seems to me, should be regarded in any purely mathematical development as one of those "undefined" terms with which every formal deductive system begins, but which are promptly associated with something in the real world of experience, just as are the terms "point," "line," and "weight." The basic experiences best associated with probability are of repetitive situations observed to differ one from another in particular details. If the proposition of cases in which a certain detail occurs remains roughly constant among different substantial groups of such observed situations, where the grouping is believed irrelevant to the presence or absence of this detail, we may summarize the situation by saying that there appears to be a constant probability, a number between 0 and 1, attached to such situations, such that the frequency ratios found by observation tend to approximate this number. We go on to attribute to this number and to the empirical situation the properties assumed in the mathematical theory, and may estimate this probability as equal, or in some definite way nearly equal, to the observed frequency ratio in our available observations of the kind, all put together. This process is a step in a process of what in recent decades has come to be called "model building," which is essential for our orderly understanding of the world as a world of law rather than of disconnected events.

Probabilities of particular events may be estimated in many ways besides observing these exact events in long series of occasions. For example, though the probability of each face of a die appearing on top at a toss is supposed to be 1/6, this property may readily be found not to hold for many commerical dice, even without a single toss, merely by examination and perhaps measurement of the alleged cube. Such conclusions may often be verified by a few tosses. On the other hand, some well-made dice display the correct proportions quite closely in many thousands of trials. E. U. Condon once determined experimentally an empirical curve whose ordinate gives, to a close approximation, the probability of a square parallelepipedon coming to rest on a square face when thrown, in terms of the ratio of two different edges which appears as the abscissa of his graph. Thus anyone, without making any sequence of tosses whatever, can not only ascertain the probability of an end of a square die coming up, but can ascertain it before the die is even made, and indeed can make the probability what he will, to a close approximation, by using Condon's graphic relation and suitable care in manufacture.

Probabilities may also be estimated by other methods, including calculations from other known probabilities. But always, for results that one can hope to find verified by further observations, there must be lurking somewhere in the background an adequate body of actual observations. The deductive theory alone cannot make valid unconditional prophecies of the results of observations, though it can make *conditional* prophecies, subject to definite probabilities and valid on conditions such as that dice are fair and that other features of the model are as assumed.

At this point we may re-emphasize George Boole's condemnation of "the equal distribution of ignorance," whereby equal probabilities are assigned to alternatives if only nothing is known to favor one against another. Keynes resuscitated and improved this old notion in his "principle of indifference," which we may restate in slightly altered language: If the evidence is symmetrical, so that all that can be said relevantly for one alternative can be said for another, and if these alternatives are not divisible into others of the same form, then they are equally credible. The qualification regarding subalternatives of the same form was inserted by Keynes as a safeguard against the infinite divisibility of infinite aggregates such as the points on a line segment, which had given rise to many historic fallacies regarding probabilities.

These fallacies arose partly from such truths as that a line a yard long has exactly as many points as one a foot long, even though it does have more inches. But largely they resulted from the confusion between probability and credibility. The equal distribution of ignorance and the principle of indifference cannot safely be applied to probability without factual verification. They can be applied to credibility, but in this case Keynes' indivisibility condition is not needed.

There are indeed situations in which valid information about probabilities can be deduced from rather broad conditions, as in ergodic theory and in the various limit theorems specifying particular forms, such as the normal law for the distribution of functions of a large number of variates, with an approximation that improves as the number of constituent variates increases. These supply some warrant for using the normal law as a tentative approximation for particular variates, but the normal law is often negated by facts, and in the absence of adequate factual investigation the common practice of imputing a normal distribution to almost everything may lead to serious mistakes. Ergodic theory may likewise prove misleading if not supplemented by actual observations. For example, ergodic theory includes theorems asserting—of course on the basis of certain mathematically stated conditions—that after a large number of shufflings of a pack of cards all permutations of the cards are equally probable, apart from small deviations that approach zero as the number of shuffles increases. But to pass from this to the conclusion that in a particular shuffled pack the permutations are all equally probable, without first checking details of the method of shuffling or examining the result, is an error that has cost some people a good deal of money. Even the existence of a probability in particular circumstances is not to be assumed too hastily; not all sequences of trials exhibit a tendency to stability of the relative frequencies of particular types of outcomes. Here again, as in all physical, biological and social sciences, we can go some way with theoretical models, but do not remain satisfied without observational checks on our deductions at as many parts of the structure as possible.

A credibility, as a relation between antecedents and an uncertain consequence, may be described as a degree of rational belief, though not always of actual belief. The concept is a logical rather than a psychological one, and possesses objectivity without always being "well-ordered" or having numerical measure. A credibility coincides with a probability only in certain special cases in which probabilities exists and are known. There are other cases in which probabilites are not definitely known, though there is some evidence about them that may not be entirely decisive. Such situations exist in abundance, and lend themselves to the application of credibility theory, using the few canons of credibility that we possess to provide an ordering among the possible sets of values of the unknown probabilities. We then have the *likelihood* introduced by R. A. (now Sir Ronald) Fisher as a basis of *estimation*, that is, of selection among the possible values of a parameter in the light of observations. Fisher's rule is to adopt as an estimate of the parameter that value for which the likelihood, defined as the probability of the actual observations, is a maximum.

Statistical inference differs from pure mathematics in that its main objectives are inductions based on observations, whereas pure mathematics is concerned primarily with deductions from specified premises. Mathematical probability theory proceeding from probabilities supposed known calculates with presumed certainty the probabilities of other events, including anticipated observations. The statistician faces the inverse of such problems; he reasons, never with complete certainty, from observations back to the causal relations presumed to have led to these observations, and in doing so makes inferences about any probabilities that may be intervening to produce loose coupling between cause and effect.

Specification, Estimation, and Testing

Science proceeds, as is well known, by a cyclical process of getting observations, looking for uniformities and contrasts in them, formulating theories or "models," and getting more observations. These latter observations may result in confirmation or contradiction of the theory, and in case of contradiction, to modification of the theory in some detail, such as introducing a new kind of force into a physical model; or more rarely to a drastic rebuilding of the model, such as the replacement of the Ptolemaic by the Copernican theory of planetary motion.

Models usually involve unknown quantities, which generically we call parameters, and to which reasonable values can be assigned only as functions of observations. A parameter to be estimated from suitable observations may, for example, be the velocity of light, or it may be the value of a linkage coefficient for a pair of genes in fruit flies, or it may be the long-run value apart from sampling fluctuations, of a multiple correlation coefficient between scores on a group of psychophysical measurements of young men applying to the Air Force for flight training and a measure of the later success of these same young men as fliers. Thus the making of observations, and of experiments to produce observations, has another purpose than the testing of models; it is for the sake of estimating parameters that many, perhaps most, scientific observations are made.

But there is more to the estimation of unknown parameters than the making and recording of observations. Methods of passing from observations to estimates are so numerous that different scientists using the same record of observations may reach different estimates of the desired quantities. Where one uses an arithmetic mean another may use a median and another a geometric mean.

Fisher describes five different plausible methods of estimating the same genetic parameter from the same experimental results, with wide discrepancies possible in the estimates. A geneticist who did not know about the theory of estimation might easily follow whichever method first entered his head.

Observations are afflicted by variations which in some contexts are called errors of observation, and in some others biological variation. These will generally create discrepancies between the best of models *that do not involve probability* and relevant observations. These discrepancies are the usual source of the differences between the results of applying different estimating formulae, such as the various kinds of means, to the same data. Little can be done after an experiment has been performed to reconcile such differences except by injecting an element of probability into the model. Just how this is to be done must be decided on the basis of what is known about the facts of the variation, with considerable light available from general statistical theory and experience. Both facts and theory should be used. There are certain relatively simple probability models that have proved widely useful, such as that of normally distributed independent errors with a common mean and variance; but the applicability of any such model needs scrutiny in each case.

Once the probability model is adopted, the question of an estimation formula may be approached objectively. Criteria of good estimates emerge, such as unbiasedness and minimum variance, and after appropriate mathematical investigations lead to definite formulae, with little or no ambiguity arising from the slight differences in the sets of criteria that have been suggested as reasonable. Each estimating formula—or "statistic"—has its own variance, resulting from that of the errors or other basic source of variation. Among otherwise acceptable "statistics" a choice may be made of that one with minimum variance. This was one of the ways in which Gauss and Laplace arrived at the method of least squares early in the last century.

If a statistic is used whose variance is greater than the minimum possible among an acceptable class (for example of unbiased statistics), it is inefficient, and its efficiency is measured by the ratio, less than unity, of the minimum variance to its own. In typical cases the variance of the statistic is inversely proportional to the number of observations, so that the efficiency shows what proportion of the observations need not have been made if a fully efficient statistic had been used with the same accuracy as the inefficient statistic applied to the larger number of observations.

For a random sample from a normal probability distribution the most efficient unbiased estimate of the center of the distribution is the arithmetic mean of the sample. The efficiency of the median for this purpose is approximately 63 per cent. The most efficient unbiased estimate of the variance of this normal distribution is the sum of the squares of the deviations of the observations from their mean, divided by one less than the number of them. Some people object to the labor of calculating and adding these squares, especially if, as usually happens later, the square root of the statistic is to be found also. There is therefore a tendency in some quarters to use the mean deviation, that is, the average of the absolute values of deviations from the sample average. This statistic has an efficiency of about 87.3 per cent, and therefore requires an increase of about one-seventh in the number of observations for any specified accuracy.

In shooting at and bombing targets the general experience has been of errors having very nearly normal distributions. It is therefore to be expected that the mean square deviation would be used as an estimate of the variance, and its square root, the sample standard deviation, as an estimate of the standard deviation of the probability distribution. Nevertheless, the fact came to light during the second world war that our armed services were using the mean deviation to measure the dispersion of fire, thereby sacrificing the information obtainable from about one shot in eight. Even if this were tolerable for pistol fire, its application to large battleship guns for which the reputed cost of firing was in the neighborhood of $100,000 a shot, can scarcely be justified. One wonders whether the calculations based on the results of firing today's enormously more costly missiles are likewise being simplified to avoid squaring a few numbers and extracting a square root, at a cost of one missile in eight.

The value found for a statistic has traditionally been accompanied by its probable error. A modern and more exact substitute is the fiducial or confidence interval around the estimate, with the ends of the interval determined by the observations in such a way that the probability that the interval will include the true value of the parameter estimated has exactly a preassigned value, for example .99. This can be managed readily in the simpler cases, and can be extended to more than one parameter. Thus an elliptical confidence region can be set up for two regressions coefficients found in the same least squares operation, with the chosen probability holding exactly for the event that the true values of the two coefficients are the coordinates of some point within the ellipse.

It should be noticed particularly that these confidence intervals and regions can be determined fully, with exactly correct probabilities, without ever assuming any a priori probability distribution for the parameters. This often seems paradoxical, for how can one speak of the probability that a parameter lies in an interval when the parameter has no probability distribution? The answer is that the ends of the interval vary at random in repetitions of the experiment, while the parameter point remains fixed.

Paradoxes of this kind arise frequently from a verbal

practice that should be noticed, in which the logical and the psychological implications differ. We feel it better to say "John will soon be taller that his mother Mary" than "Mary will soon be shorter than her son John," though both statements are verbally correct, they are precise logical equivalents, and the credibility of one is the same as that of the other. We seem to feel, without stating explicitly, a collateral proposition to the effect that the person first named is the active one, with John growing in the first case and Mary's stature shrivelling in the second. A similar interchange of subject and predicate in Fisher's argument introducing his fiducial probability concept, with differing logical and psychological implications, is involved in the controversy of this subject.

Tests of significance, or tests of hypotheses, are the subject of an extensive development of theory and practice closely allied but not identical with estimation. Many of the common cases of testing and estimation can be dealt with in a demonstrably optimum manner by starting with the least-squares procedures of Gauss and Laplace, and then using an adaptation by which the final probabilities for the confidence intervals and tests of significance are obtained from the variance ratio distribution of Fisher or its special case, the Student distribution.

There have of course been many other developments in the fields of estimation and testing. The basic work of Fisher, Neyman and Pearson has been extended by many others. Particularly notable is the growing search for and supply of exact probability distributions, exact both in the sense of mathematical exactitude replacing the older approximations, and in the newer statistical sense that requires the distribution to be free of unknown parameters. The latter requirement is often frustrated, apparently by the inner nature of the situation, but methods of circumventing the difficulties have been devised in many cases, though not in all.

The Design of Experiments

After the developing theories of estimation and testing had emphasized efficient methods of combining observations already obtained, it became evident that large additional gains were attainable if the experiment or the sample survey or the observational program could be designed with suitable consideration for the effect of the design on such things as the standard errors of the results. Fisher's book *The Design of Experiments*, of which the first edition appeared in 1935, emphasized the principles of replication, randomization and stratification as esssential to the design of experiments that should be *valid*, satisfying the "conditions of knowledge" of which the dictionary says metaphysics is the science, and should also be *efficient*. The book, which also contains many other ingenious ideas making for ampler knowledge and for efficiency, brought about a vast change in experimental methods, first in agricultural and then in medical and genetic experimentation, and now in industrial experimentation and many other things. At the same time the ideas of this book came to be applied to the conduct of sample surveys, first on a large scale in India.

The series of sample censuses of jute acreage in Bengal conducted under the leadership of P. C. Mahalanobis, a physicist turned meteorologist and then statistician, has been remarkable for the skillful applications of mathematics and of the basic principles of experimental design that have gone into it, and the innovations in sample survey technique that have come out of it to be available for such surveys everywhere. Incidentally, two of the executive supervisors of these Bengal surveys in the 1930's, R. C. Bose and S. N. Roy, are now members of this chapter of Sigma Xi and professors in the University of North Carolina.

The application of Fisher's basic principles of experimental design in numerous fields has called forth a great number of special designs for particular purposes, and has also evoked a remarkable series of investigations by R. C. Bose and his students in the combinatorial mathematics and group theory and number theory needed for devising the larger designs, too numerous and complex to tabulate, which will undoubtedly be wanted soon to play a part in the accelerating experimental activity of our time.

Sequential Experimentation

Sequential designs are distinguished from designs that are completely fixed before any observations are made. Probably the earliest of these are the multiple-sampling plans originated by Shewhart, Dodge, Romig and Bartky, all working in the Bell Telephone Laboratories. The application then in view was the sampling inspection of routinely produced articles for quality control. In single sampling plans one sample of size specified in advance is taken from a large lot, and the decision whether to accept or reject the lot depends strictly on whether the number of defective articles in the sample is or is not less than a certain number, also fixed in advance. In multiple sampling plans, one of three decisions is made after the first sample on the basis of the number of defectives in it: either to accept the lot, or to reject it, or, in intermediate cases, to take another sample. If the multiplicity of the plan is two, the sampling ends after either the first or the second sample; in plans of higher multiplicity, more samples are possible, always according to fixed rules, and the maximum possible number of samples is fixed in advance. A well-designed multiple sampling plan is more efficient than single sampling in the sense that, for any particular limits on the probabilities of the two main kinds of error—accepting an undesirable lot and rejecting a desirable one—the expectation of the total of the sample sizes is less for the multiple than for the single sampling.

A further gain in efficiency, at least in certain simple

cases, was achieved by Abraham Wald in 1943 by removing the limit from the number of samples. The Wald sequential method was promptly seized upon by the Army Quartermaster Corps, and as a result came into use in more than two thousand factories supplying the army before the end of the war. The conceptual jump from a definitely finite to a conceivably infinite number of observations was a large one. The mathematics required for this sequential method is in some respects simpler and in some respects more elaborate and unfamiliar than for the older methods.

Further work on sequential experimentation was conducted in the Statistical Research Group at Columbia University during the war, and after the war by some of its scattered members and others. As the subject has progressed, increasingly difficult mathematical problems have been encountered and have slowed the advance. But the obviously great importance of the idea offers a basis for expecting that the technical difficulties will be resolved, and that a much increased proportion of future experimentation will follow definite sequential plans defined in advance, as it has always followed informal and therefore less efficient sequential procedures.

A more elaborate kind of sequential experimentation is to be expected in the future, in which a decision to continue experimenting will be accompanied by a much more detailed decision regarding the design of the next stage of the experiment. Thus in crop experiments the proportions of the available land to be put into the several varieties compared may well change from year to year in response to the accumulated information. More generally, an important objective of the early stages of an experiment should be to gain information that will help to design more efficient, and often larger, experiments later.

This more general kind of sequential experimentation envisioned for the future will involve stochastic processes, If the most efficient design for each stage is a function of p parameters that are unknown but can be estimated with increasing accuracy as the experimentation proceeds, we may envision the sequence of designs as a sequence of points hopping along in a p-dimensional space, with the probability that the next little hop will have a particular length and direction a function of the coordinates of the point from which the hop takes off. Such considerations could lead us to differential quadratic forms, which are the stuff of which metric differential geometry is made. So maybe the differential geometry that has reached such great heights in the century since Riemann's Hauptschrift and has served so well in general relativity theory can be brought to bear on the hard problems of sequential experimentation of this generalized kind.

Decision Functions and Pragmatic Philosophy

A test of significance leads to a decision to reject or not to reject a hypothesis, which means essentially to believe or disbelieve it. Estimation leads to a decision to regard an unknown quantity as lying between limits determined in a certain way by the observations. Sampling plans lead to the acceptance or rejection of lots of manufactured articles. With the help of discriminant functions based on studies of past Air Force flight training cadets, decisions are made to accept or reject candidates for flight training when their scores on certain tests have been found. A separate decision must be made after each stage of a sequential experiment.

Thus statistics is heavily involved in decisions. A general theory of decision functions was initiated by Wald, with the aim of covering the many kinds of situations requiring decisions, or at least clear-cut statistical situations, in one grand generalization.

The goodness of a rule for making decisions must be gauged by the probabilities of the rule leading to all the various possible kinds of decisions, and by the goodness or badness of the consequences of each of these possible decisions. For example, a rule for a statistical test of a hypothesis may tell us to accept the hypothesis if a certain function of the observations lies in a particular interval, and otherwise to reject the hypothesis. Such a rule is to be judged by two criteria: (I) Its probability of rejecting a true hypothesis, (II) Its probability of accepting a false hypothesis. To try to find a good rule we may well begin with the minimizing of one of these types of error while holding the other fixed. The most extensively used methods of modern statistics are derivable by procedures beginning in this way. There are further complications in the procedure, but this is enough to illustrate one very important point about statistical decisions:

Statistical decisions, including some decisions about the beliefs we shall hold, are when rational based on the probable consequences of the various possible decisions.

Now this is pragmatic philosophy in action.

In the long search for an answer to Pontius Pilate's question "What is truth?" the American philosopher William James early in this century put forth an answer to the effect that truth consists of those beliefs whose holding will, all things considered, make for the greatest happiness of the greatest number of people, now and hereafter. In other words, truth is to be judged by consequences. This inadequate summary seems to lay pragmatism open to a suspicion of immorality, but James' fuller statement anticipates and deals effectively with this objection.

Before the emergence of modern statistical theory, Laplace and his many followers sought vainly for probabilities of causes or of hypotheses in order to decide what to believe. This procedure is now replaced by decision rules which apply directly the criterion that truth is to be judged by consequences, and are thus in harmony with the pragmatism of James.

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By Donald W. Paden, University of Illinois and E. F. Lindquist, University of Iowa. Second Edition. 299 pages, $4.90

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QUESTIONS AND ANSWERS

Edited by ERNEST RUBIN
U. S. Department of Commerce and American University

Probability for the General Reader and Others

During the past few years a number of requests have been received for a list of references on probability similar to that which appeared in this column for statistics (October 1956). Teachers, students, statisticians and others inform me that such a list, with brief comment, would be useful.

The development of probability and statistics has been a reflexive one during the last three centuries, especially since Halley constructed the first life table in 1693. A great deal has been written on both subjects for about three centuries so that any list of works on probability must necessarily be selective. In preparing this list I have examined many books, book reviews, and have consulted several mathematicians and statisticians.

Several points should be made at the outset of this discussion. Many of the books cited contain bibliographic references, generally at the end of each chapter or as a separate section at the end of the book. In general, I have omitted references to articles on probability that have appeared in journals of mathematics, statistics, philosophy and encyclopedias; primarily for the reason that these are too numerous to mention. Many of the books referred to in the following discussion have been reviewed at length in the professional literature, including the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION.

Although it may appear somewhat old-fashioned I wish to refer at the beginning to works on the history of probability. Originally published in 1865, *A History of the Mathematical Theory of Probability from the Time of Pascal to Laplace*, by I. Todhunter (Chelsea Publishing Co., New York, 1949, pp. xii, 624) is the classic account of probability developments in the period 1575 to 1825. Todhunter traces in considerable detail the complex evolution of the subject, discussing many interesting problems and their solutions. A substantial part of this work is comprehensible to persons familiar with elementary mathematics, especially college algebra. There are, however, many topics that require calculus and higher mathematics for a complete appreciation of the discussion. Todhunter's work is also valuable as a reference and for the description of various problems in applied fields.

E. Czuber continued the development of probability to the end of the nineteenth centry in "Die Entwicklung der Wahrscheinlichkeitstheorie und Ihrer Anwendungen," (*Jahresbericht der deutschen Mathematiker-Vereinigung*, Leipzig, 1899, Vol. 7). I am not familiar with a book on the history of probability covering the period 1900-1950.

Before turning to modern treatises, reference must be made to a classical discussion of probability. I refer to *A Philosophical Essay on Probabilities* by Pierre Simon Laplace, a book based on lectures delivered in 1795. (Translated from the Sixth French Edition by Truscott and Emory, introduction by E. T. Bell, Dover Publications, New York, 1951, pp. vi, 196). This book contains an analysis of the principles of probability and the application of the theory to many topics such as games of chance, tables of mortality, the probability of judgments by tribunals, the creditability of evidence, fallacies in probability reasoning and various references of historical interest. The exposition is entirely non-mathematical and is quite lucid in analyzing the basic concepts of probability In my opinion it is a good introduction to the subject, especially for the non-mathematically trained reader. Despite the absence of mathematical representation Laplace discusses several intricate aspects of this subject.

Valuable insights into the nature and characteristics of probability have been provided by examinations of this subject from the standpoint of philosophy and logic. Before describing books of a more mathematical-statistical orientation reference must be made to some of the important works in this field. In 1854 George Boole wrote *An Investigation of the Laws of Thought on Which Are Founded the Mathematical Theories of Logic and Probabilities* (Dover Publications, New York, 1954, pp. 424). This study is considered a very significant work in the development of probability. Important works on probability connected with the domains of philosophy and logic have been written by Venn,[1] Peirce,[2] Keynes,[3] Nagel,[4] Reichenbach,[5] Mises,[6] and Carnap.[7]

Turning now to mathematical probability, I call atten-

1. J. A. Venn, *The Logic of Chance*, (MacMillan, London, 3rd Ed., 1888).

2. C. S. Peirce, *Chance, Love, and Logic*, (Harcourt Brace, New York, 1923).

3. J. M. Keynes, *A Treatise on Probability*, (MacMillan, New York, 1921). This book contains an extensive bibliography, pages 431-458 inclusive.

4. E. Nagel, "Principles of the Theory of Mathematical Probability," *International Encyclopedia of Unified Science* (University of Chicago Press, 1939, Vol. 1, No. 6).

5. H. Reichenbach, *The Theory of Probability*, (University of California Press, 1949, 2nd Ed.).

6. R. von Mises, *Probability, Statistics and Truth*, (MacMillan, New York, 1957, 2nd Ed. Revised by H. Geiringer).

7. R. Carnap, *Logical Foundations of Probability*, (University of Chicago Press, 1950).

tion to the great classic works of Bertrand,[8] Poincare[9] and Borel.[10] Of special use is the monograph by Emile Borel and Robert Deltheil, *Probabilités, Erreurs* (Libraire Armand Colin, Paris, 2nd Ed., 1926, pp. vi, pp. 197). This monograph begins with the elementary concepts of probability, develops the theoretical aspects of the subject and applies the principles to problems in the natural sciences from a statistical point of view.[11] Mention should also be made of Arne Fisher, *The Mathematical Theory of Probabilities and Its Application to Frequency Curves and Statistical Methods* (MacMillan, New York, 1915, pp. xx, 171).

A standard work in classical probability theory in English is *An Introduction to Mathematical Probability* by Julian Lowell Coolidge (Oxford University Press, 1925, pp. viii, 216). Coolidge includes a discussion on the principles of life insurance. An early book to apply probability in the modern statistical sense was *Probability and Its Engineering Uses* by Thornton C. Fry (Van Nostrand, New York, 1928, pp. xiv, 476 pp.). Although dated, Fry's book remains worthwhile because of his approach and because of the problems he treats.

In the last four decades classical probability theory has been modernized. This transformation means the generalization of probability theory by the use of axiomatization, of set theory, topology, and of abstract Lebesque integration. A systematic presentation along these lines was made in 1933 by the Russian mathematician A. Kolmogoroff, *Grundbegriffe der Wahrscheinlichkeitsrechnung* (Chelsea Publishing Company, New York, 1946, pp. iv, 62). An English version, *Foundations of the Theory of Probability*, Translated by N. Morrison (Chelsea Publishing Company, New York, 1950, viii, p. 71) is also available. Although brief, this study is a formal presentation of probability at an advanced mathematical level. The recent work by Michel Loeve, *Probability Theory: Foundations, Random Sequences*, (Van Nostrand Co., New York, 1954, pp. xv, 515), although beginning with elementary concepts, rapidly moves into the advanced phases of this subject. Loeve's work is strictly for graduate mathematicians.

Since the 1940's many books have been written which combine probability and statistics. Before referring to the more formal treatments of these subjects, I think the reader who is interested in a popular and enjoyable treatise should look at Lancelot T. Hogben, *Chance and Choice, by Cardpack and Chessboard* (Chanticleer Press, New York, 1950, 1955, 2 volumes pp. 917). Six interesting essays on probability are reproduced in volume 2 of the *World of Mathematics*, ed. by J. R. Newman (Simon & Schuster, New York, 1956, 4 volumes) at pages 1315-1414. More specifically, I will now list without comment relevant works which require as a minimum at least one year of calculus and that peculiar quality described as mathematical maturity:

(1) Trygve Haavelmo, *The Probability Approach to Econometrics*, (University of Chicago Press, 1944, pp. viii, 118);

(2) F. N. David, *Probability Theory for Statistical Methods*, (Cambridge University Press, 1949, pp. ix, 230);

(3) N. Arley and K. R. Buch, *Introduction to the Theory of Probability and Statistics*, (John Wiley, New York, 1950, pp. 235);

(4) W. Feller, *An Introduction to Probability Theory* (John Wiley, New York, 1957, 2nd Ed., pp. xv, 461);

(5) J. Neyman, *First Course in Probability and Statistics* (Henry Holt, New York, 1950, pp. ix, 350).

(6) L. J. Savage, *The Foundations of Statistics*, (John Wiley, New York, 1954, pp. xv, 294);

(7) H. Cramer, *The Elements of Probability Theory and Some of Its Applications* (John Wiley, New York, 1955, pp. 281);

(8) Maurice S. Bartlett, *An Introduction to Stochastic Processes*, (Cambridge University Press, 1955, pp. xiv, 312).

(9) M. G. Kendall, *The Advanced Theory of Statistics* (C. Griffin, London, Vol. I, 1943 and Volume II, 1946). Volume II contains a detailed bibliography.

(10) M. Frechet, *Generalités sur les probabilités. Elements Aléatoires* (Gauthiers-Villar, Paris, 1937).

I trust that the foregoing works will usefully serve readers interested in pursuing their study of probability and statistics. The mathematical and statistical journals here and abroad carry the latest developments in these fields. Only after achieving some mastery of these subjects is it desirable to consult the professional journals. In many respects probability is the most fascinating, and in its applications, the most practical branch of mathematics.

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8. J. L. F. Bertrand, *Calcul des Probalités*, (Gauthier-Villars, Paris, 1889).

9. H. Poincaré, *Calcul des Probabités*, (Gauthier-Villars, Paris, 2nd Ed., 1912).

10. E. Borel (ed.), *Traité du calcul des probabilitiés et de ses applications* (Gauthier-Villars, Paris, 1939, 4 vol.).

11. For the reader interested in a brief, pre-calculus discussion of probability see Chapter XXXII "Probability" in H. S. Hall and S. R. Knight, *Higher Algebra*, (MacMillan, New York, 4th Ed., 1904) pp. 373-408.

is Chairman of the Polish Planning Commission, a member of the Sejm (Parliament), and advisor to the Indian Government, in addition to his academic duties at the University of Warsaw.) The publication referred to is *Wstep Do Ekonometrii* (Introduction to Econometrics), published in 1958 in Warsaw, 370 pages, in Polish. Not quite half the book is devoted to linear programming and input-output analysis. I suggested to Lange the possibility of translation of this work because of the interest in this subject in the U.S. and the United Kingdom. It is my impression that Lange is considering an English version of the book."

Dr. Rubin gave several lectures during his stay in Poland. At the Polish Economic Society in Warsaw, he spoke on "Trade, Migration, and Economic Growth"; at the University of Warsaw he spoke on "Statistical Distributions in Nature and Society"; at the Advanced School of Commerce in Sopot his talk was "Interrelations between Trade and Migration," and at the University of Jagiello in Krakow, he led a seminar on the subject of "U.S.-Polish Trade Development."

SWEDEN

The Director of the Central Bureau of Statistics, **Professor Karin Kock,** resigned at the end of 1957. **Dr. Ingvar Ohlsson,** formerly chief of the Econometric Section of the Ministry of Finance, was appointed to succeed Professor Kock.

The Central Bureau of Statistics, established in 1858, is celebrating its centenary in 1958. Professor Kock is in charge of preparations for a memorial volume.

Electronic computers will be used for the first time in connection with data-processing for the 1960 Population Census.

Consumer Price Index. In April 1958, experts were appointed by the government to investigate the consumer price index and to make proposals for supplementary index series. [In *Statistisk Tidskrift*, it is indicated that the group of consultants includes Director General Ernst Bexelius of the Ministry of Finance (chairman), Lennart Fastbom, Sten Malmquist, and Erland von Hofsten.]

Registration of cancer was started January 1, 1958, by the Board of Health. This program, initiated by a Royal Decree of November 22, 1957, is intended to facilitate the study of the frequency of the disease.

—Dr. Ingvar Ohlsson, Director
Central Bureau of Statistics
Stockholm

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NEWS ABOUT MEMBERS

T. W. Anderson has returned to Columbia University as Professor of Mathematical Statistics and Executive Officer of the Department of Mathematical Statistics, after a year's leave of absence as a Fellow at the Center for Advanced Study in the Behavioral Sciences (Stanford, California).

George C. Andrews accepted in May a position with Stewart, Dougall & Associates, Inc., New York City, a firm of consultants. On July 1, he was made Manager of the Technical Services (Statistical) Department, which does the sampling and statistical work for both Stewart, Dougall and its affiliate, Crossley, S-D Surveys, Inc.

John C. Atkinson has left the Agricultural Research and Development Department of Chas. Pfizer & Company in Terre Haute, Indiana, where he served as statistician, and joined the Medical Research Directorate of Chemical Warfare Laboratories at the Army Chemical Center as the statistician.

Robert R. Behlow, formerly Regional Director of the Mid-Atlantic Regional office of the Bureau of Labor Statistics, New York City, has been appointed to the International Cooperation Administration where he will serve as Program Economist with the ICA mission in Teheran, Iran.

Herbert Bienstock, who has been Regional Analyst for Manpower and Employment with the Bureau of Labor Statistics, has been appointed Acting Director of the Mid-Atlantic Regional office in New York City.

Dorothy S. Brady is now Research Professor in Economics in the Department of Economics of the Wharton School, University of Pennsylvania. In this position, she will continue a series of studies of consumption and the income distribution, and participate in the program of courses in quantitative economics.

Robert C. Brooks is now Assistant Professor of Business Administration at Vanderbilt University.

Marion R. Bryson has resigned as Associate in Statistics at Iowa State College to accept a one-year appointment at Duke University doing statistical research for the Office of Ordnance Research.

Norman Bush is currently enrolled as a graduate student at the Department of Statistics, University of North Carolina.

Donald D. Christenson is now Assistant Professor of Administration at the University of Wichita.

Robert Cochran has joined the Mathematics Department of Kansas State College where he will be teaching courses in the elements of statistics, statistical quality control and college algebra.

Edmund A. Cotta has resigned as Assistant Budget and Cost Controller at Snellenburgs in Philadelphia to accept a position as Assistant Professor of Marketing at the Long Beach State College in Long Beach, California.

Murray D. Dessel has transferred from the Office of Area Development, Commerce Department, to the Office of the Assistant Director for Statistical Standards in the Census Bureau.

Sanford M. Dornbusch, formerly of Harvard University, has joined the Department of Sociology at the University of Washington with the rank of Associate Professor. He has been awarded a Faculty Research Fellowship by the Social Science Research Council for the period 1958-1961.

Louis J. Ducoff, Assistant Chief of the Farm Population and Rural Life Branch, U.S. Department of Agriculture, has returned to his post after a 13-month absence on a United Nations technical assistance assignment for a demographic study of Central America and Mexico in relation to their economic development programs.

Jean Engler is spending the second year of her post doctoral National Science Foundation Fellowship at the Department of Statistics, Harvard University.

William A. Ericson received an M.A. degree in Economic Statistics in June from the University of Pennsylvania. After summer employment as Research Associate for the Commonwealth of Pennsylvania, he is now working towards at Ph.D. in Statistics at Harvard University.

Robert B. Fetter has accepted an appointment as Associate Professor of Industrial Administration at Yale University.

Peter W. Finkel is now the General Manager of the Friend-Rent-A-Car-Service in Washington, D.C.

Alexander Ganz has returned to Washington after 6½ years as an economist with the United Nations Economic Commission for Latin America in Santiago, Chile and is now a member of the economic consulting firm of Robert R. Nathan Associates.

Landis S. Gephart, formerly Chief of the Design of Experiment Office, Office of Ordnance Research, Durham, North Carolina, has accepted the position of Scientific Advisor to the U.S. Army Research and Development Liaison Group and will be stationed in Frankfurt, Germany.

William Gravet, formerly at Boston University, is now head of the Computing Center at Oklahoma State University, Stillwater, Oklahoma, with the rank of Assistant Professor.

Shanti S. Gupta spent the academic year 1957-58 at the University of Alberta as Associate Professor of Mathematics and has now returned to the Bell Telephone Laboratories, Allentown, Pennsylvania as a member of the Technical Staff.

Bernard Harris has resigned his position as Mathematician with the Department of Defense and has accepted an appointment as Assistant Professor of Mathematics at the University of Nebraska.

Roger K. Harter is now a General Staff Supervisor with the Michigan Bell Telephone Company in the Business Procedures Organization. He is working on automatic programs for the Burroughs 220 computers.

Robert W. Heath is now with the Applied Research Laboratory of the University of Arizona. He is engaged in estimating manpower and skill requirements for the Signal Corps.

Myron S. Heidingsfield, formerly Professor of Marketing at Temple University, has now been appointed Manager, Market Research, RCA Victor Television Division, Radio Corporation of America.

Richard C. Henshaw, Jr. has accepted an appointment as Distinguished Visiting Professor of Business Administration at Michigan State University for the 1958-59 academic year to develop a program in quantitative methodology for the doctor's degree in the College of Business and Public Service.

John R. Hills' position involves advising, consulting, and supplying data-processing services for the testing programs of the twenty college units (junior colleges, senior colleges, technical institutes, the teachers college, the medical college, and the state university) of the Georgia University system.

Daniel G. Horvitz conducted a Seminar on Consumer Surveys under the sponsorship of the Marketing Research Committee of the American Gas Association. His topic was "Sources of Bias."

Berne L. Jacobs, Jr. has taken a position as Instructor in the Department of Psychology at the University of California at Santa Barbara.

John Johnston is Visiting Associate Professor in the Department of Economics, University of Wisconsin.

Carol Kramer has left the Chicago Area Transportation Study and is now employed by Eastman Kodak as a programmer in their Department of Scientific Computing, Rochester, New York.

T. T. Kwo's new position is Director, Business Research and Statistics, Loew's Inc., New York City.

Lonnie L. Lasman received a Ph.D. degree from North Carolina State College in July 1958 and is now Assistant Professor of Mathematics at Florida State University.

George W. Lerch has received a Fellowship from the Department of Defense to do additional post-graduate work at Harvard University.

Robert F. Lewis has been appointed Assistant Professor of Biostatistics in the Department of Tropical Medicine and Public Health of Tulane University.

Ronald H. Lewis has joined the Engineering Staff of Republic Aviation Corporation, Guided Missile Division, Mineola, New York, as Senior Weapon Systems Analysis Engineer.

W. Charles Mayhew has returned to Penn State for graduate study in Industrial Engineering.

Chalmers A. Monteith has been appointed Assistant Professor of Economics at Kent State University.

Ernest Ni is Analytical Statistician (Dem-

ography), Division of Population, Bureau of the Census, Washington, D.C.

Robert J. Paulis has been appointed Associate Professor of Business Administration at Bradley University, Peoria, Illinois.

John E. Pearce has recently been appointed Director of Economic Research for Foremost Food and Chemical Company, Oakland, California. He was formerly with International Minerals and Chemical Corporation, Skokie, Illinois.

William Peterson is a Senior Postdoctoral Fellow of the National Science Foundation, Amsterdam, The Netherlands. His project is to study the cultural determinants of Holland's high birth rate.

Philburn Ratoosh, on leave from the Ohio State University, is Visiting Associate Professor of Psychology at the University of California, Berkeley, for 1958-59.

William B. Rider, formerly with the Pan American Petroleum Corporation, Tulsa, Oklahoma, has accepted a position with the Electro Data Division of the Burroughs Corporation, Pasadena, California.

R. A. H. Robson has joined the faculty of the Department of Anthropology, Criminology and Sociology at the University of British Columbia.

Irving Roshwalb has been appointed Director of Research of Gallup & Robinson, Inc., advertising and market research firm in Princeton, New Jersey. He was formerly Vice President and Technical Director of Audits and Surveys, Inc., New York City.

Abe Rothman, who has been Acting Chief of the Office of Statistical Standards, Bureau of Labor Statistics, has been appointed Chief.

John B. Rothrock, formerly Technician-Consultant in International Trade Statistics with the Inter-American Statistical Institute, has been appointed Director of the Office of Financial Services and Treasurer of the Pan American Union.

Willard N. Runquist is now Assistant Professor of Psychology, Hobart and William Smith Colleges, Geneva, New York.

Redmond T. Sage has been transferred to the Quality Control Section of the General Products Division, Owens Corning Fiberglas, Toledo, Ohio as staff statistician.

John D. Sargan will be teaching at the School of Business Administration of the University of Minnesota, as Visiting Professor until June 1959.

Zane Scheftel's new duties are those of a "Survey Statistician" for the U.S. Fish and Wildlife Service at the Patuxent Research Refuge, Laurel, Maryland.

Charles H. W. Sedgewick has been appointed Supervisory Survey Statistician (Economics) in the Minerals Branch of the Industry Division, Bureau of the Census.

Maynard W. Shelly has joined the Chicago Branch of the Office of Naval Research, where he is assigned to monitoring contracts in mathematics, statistics, logistics and psychology in the mid-western area.

Donald B. Shuford is now working for the Bureau of Business and Economic Research, University of Illinois, Urbana.

Sidney Siegel has returned to his position as Associate Professor of Psychology at the Pennsylvania State University after spending the 1957-58 year as a Fellow at the Center for Advanced Study in the Behavioral Sciences.

Jack Silber spent the summer of 1958 as Consultant to the Assistant for Operations Analysis, USAF, and has returned to Roosevelt University as Professor of Mathematics and Acting Assistant to the Dean of Faculties.

Romuald Slimak has been appointed Manager, Univac Computing Center, Remington Rand Univac Division, Sperry Rand Corporation, New York City.

Walter L. Slocum, Chairman, Rural Sociology Department of the State College of Washington, is in Lahore, Pakistan for two years as advisor to the Sociology Department of Punjab University.

Walter L. Smith has resigned from his position as Lecturer in Mathematics in the University of Cambridge, England and taken up a position as Associate Professor in the Department of Mathematical Statistics, University of North Carolina, Chapel Hill.

Boyd M. Sneddon joined General Mills Marketing Research Department as a Statistical Analyst on July 1, 1958.

Gordon F. Sutton is now an Analytical Statistician in the National Office of Vital Statistics. He had previously been a Sociological Research Analyst with the Detroit Area Traffic Study.

Lorman C. Trueblood has transferred to the National Income, Labor Force, and Trade Section, Division of Research and Statistics, Board of Governors of the Federal Reserve System.

Melville J. Ulmer, Professor and Chairman of the Department of Economics at American University, is on leave for the year as a Fulbright Professor at the Netherlands School of Economics in Rotterdam.

Edward S. Weiss has returned to the U.S. Public Health Service and is now associated with the Division of Radiological Health in Washington, D.C.

Irving Weiss has been made Chief of the Economic Census Branch of the Economic Operations Division, Bureau of the Census, in Jeffersonville, Indiana. This office will be responsible for the collection and processing of returns for the 1958 Censuses of Business, Manufactures, and Mineral Industries.

Morris Wilkenfeld is teaching mathematics at Chatham Central High School, New York.

John W. Wilkinson, formerly Assistant Professor of Mathematics at Queen's University, Kingston, Ontario, has accepted a position as Research Statistician at Westinghouse Research Laboratories, Pittsburgh.

Frederick Williams, formerly at the University of Illinois, is now Associate Professor of Business Statistics at the University of Missouri, where he is teaching courses in Statistics and in the area of Operations Research.

Robert A. Wilson, formerly a Management Analyst in the Statistical Techniques Laboratory Section, Statistics Division, Internal Revenue Service, has completed the Division's Management Intern Program and has been reassigned as an Analytical Statistician in the Income, Finance, and Wealth Branch.

Pao-Lo Yu has joined the Cancer Research Laboratory of Chas. Pfizer & Co., Inc. at Maywood, New Jersey as a statistician.

CHAPTER NOTES

Albany

The Chapter opened its 1958-59 season with the annual picnic. This was held on Saturday, September 27th on the DePorte Farm at New Lebanon Center.

The first regular meeting was held October 23rd. Charles M. Armstrong, Associate Statistician in the Division of Research, New York State Education Department, spoke on "The Use of Longitudinal Models." Mr. Armstrong discussed the determination of mathematical laws for defining the growth of children, and the errors introduced when estimating changes for groups rather than for individuals.

Central Indiana

The first meeting of the 1958-59 year was held on October 9th at Purdue University. Paul H. Randolph, Associate Professor of Industrial Engineering at Purdue, spoke on "The Queueing Model." Dr. Randolph developed some simple probability models of queueing (analysis of waiting lines) and also discussed extension of the theory to more complex problems.

Central New Jersey

William B. Schrader of the Educational Testing Service was the speaker at the meeting of October 7th. His subject was "The Validation of Academic Admissions Examinations."

Chicago

A luncheon meeting was held on October 16th at which Edwin Haefele, Assistant Director, Northwestern University Transportation Center, spoke on "Chicago's Transportation Tangle: Fact and Fiction."

On October 21st the Chapter inaugurated a twin-meeting program, involving the addition of a late afternoon session on a technical subject to the usual dinner meeting. The speaker at the afternoon session, held at 4:15, was Seymour Banks, Leo Burnett & Co. Mr. Banks' subject was "Mathematical Approach to the Problem of Media Selection." The social hour and dinner began at 5:30, and were followed by a talk by Professor Harry V. Roberts, University of Chicago, whose subject was "Expert Misuses of Statistics."

The Chapter issued a four-page bulletin in October, the first of a series of six planned for the 1958-59 season. The bulletin will report news of Chapter meetings, will list job openings and job applications, will include items about members, and will carry news from the universities of interest to members. The editor is Law-

rence V. Conway, Chairman of the Public Relations Committee.

Chapter officers for 1958-59 are:

President—A. Arthur Charous
Vice-President (dinner meetings)—Lawrence R. Stickler
Vice-President (Midwest Conference)—Robert S. Seidner
Vice-President (luncheon meetings)—Leonard J. Haverkamp
Vice-President (membership)—Joseph R. Rabin
Secretary—Thomas Burke
Treasurer—Lawrence Conway

Dayton

New officers for the 1958-59 season are as follows:

President—Mrs. Jeanne Truett
Vice-President—John E. Condon
Secretary-Treasurer—John J. Stansbrey

Detroit

Robert M. Biggs, Professor of Economics at the University of Detroit, spoke at the November 13th meeting. Dr. Biggs discussed factors affecting automobile demand and the automotive outlook for 1959.

New York

The first meeting of the 1958-59 season was held on October 1st. Irving Heitner, Assistant Superintendent Operations Research, Western Electric Company, spoke on "Some Operations Research Techniques with Applications". Mr. Heitner reviewed techniques in the fields of linear programming, inventory and price break theory, and probability, and showed how probability theory in conjunction with quality control techniques could be used in developing a safety merit award plan. Discussants were Gordon Shellard, Research Associate, Metropolitan Life Insurance Company, and Professor Russell L. Ackoff, Case Institute of Technology.

At the first meeting of the Social Statistics Division of the Chapter on October 8th, Conrad Taeuber, Assistant Director of the Bureau of the Census, Howard G. Brunsman, Chief of the Population Division, and Wayne F. Daugherty, Chief of the Housing Division, discussed plans for the 1960 Census of Population and Housing. Mr. Taeuber touched upon some broad questions of policy in planning a decennial census, pointing out that the Bureau was confronted with an ever-growing variety of demands from both inside and outside the Government for information of interest to particular groups. Sample enumerators' schedules for use in a pre-test in Martinsburg, West Virginia, were distributed. Plans for obtaining many of the census items on a sample basis were described.

"The Business Outlook" was discussed at a meeting held on October 22nd. The speakers were Dwight W. Michener, Economist, The Chase Manhattan Bank; and Edwin B. George, Director of Economics, Dun & Bradstreet.

North Texas

At the first fall meeting on September 26, Dan Brock, Statistician and Analyst, Dallas City Water Works, spoke on "Sampling Techniques in the Study of Domestic Water Accounts."

The following officers were elected for the coming year:

President—Paul Minton, Southern Methodist University
Vice-President—Dan Brock, Dallas City Water Works
Program Chairman—Leroy Folks, Texas Instruments, Inc.
Secretary—Nellie Marie Barnes, Southern Methodist University

Rochester

The Chapter held its first meeting of the 1958-59 season on September 30. Professor Theodore Brown, Emeritus, Harvard Graduate School of Business, addressed the group on the subject "Business Forecasting: Philosophies and Approaches." He discussed various approaches to short-term forecasting and their implications for the present business situation. Approaches considered were historical precedent, income-expenditure analyses, the NBER leading indicators, econometric models, trend projections, and probability methods.

The following meetings were scheduled for October and November.

October 21, Professor E. H. Bowman, School of Industrial Management, M.I.T., "Operations Research Applied."

November 25, Dr. R. N. Rosett, University of Rochester, "The Statistical Analysis of Friction and Corner Maxima in Economics." This will be a discussion of problems arising in estimating relationships in which, over some range of the independent variables, the dependent variable is not or cannot be affected by changes in the independent variables.

St. Louis

At the meeting on September 17th, Terry Manns, Metropolitan Board of Freeholders, spoke on "Factors that Influence People in Their Voting". Mr. Manns described the results of a sample survey of St. Louis voters made by the Metropolitan St. Louis Survey Group. This showed that in the 1956 election income, education, and occupation were important factors, with religion having little influence.

The October 16th meeting heard Merle T. Welshans, Professor of Finance in the School of Business and Public Administration, Washington University. Professor Welshans pointed out that as security prices continue to increase the task of the investor and of the security analyst becomes more difficult, and the application of improved statistical techniques, based on expanded financial information, will be a requisite to the selection of fairly priced issues. Some examples of improved statistical applications were given.

Southern California

At the meeting of September 25th the following officers for the 1958-59 season were installed:

President—Alvord L. Boeck, Kwickset Locks, Inc.
Vice-President—Charles I. Landenberger, Pacific Telephone Co.
Treasurer—Elliot F. Beideman, Thompson Ramo Wooldridge Products
Secretary—William V. Henderson, Pacific Telephone Company

The principal speaker at the meeting was George B. Dantzig, Research Mathematician, RAND Corporation. Dr. Dantzig's subject was "Formulating a Linear Programming Model."

William R. Burkhalter, Assistant Director of Market Research, Capitol Records, Inc. spoke at the October 30th meeting. Mr. Burkhalter's topic was "Techniques of Sales and Production Planning at Capitol Records, Inc."

Washington, D. C.

"A Research Program on Human Talents: Their Identification, Development, and Utilization" was the subject of the October 22nd meeting. John C. Flanagan, Professor at the University of Pittsburgh and President of the American Institute for Research, was the principal speaker. He discussed the research plan for measuring the qualitative characteristics of the Nation's high school population, in terms of mental aptitudes and achievement levels, and for a series of longitudinal follow-up studies which have been developed under the sponsorship of several Federal agencies. Discussants were William Asher, Office of Education, Harold Goldstein, Bureau of Labor Statistics, and Howard J. Hausman, National Science Foundation.

1958 MEMBERSHIP DIRECTORY MAILED

The 1958 Membership Directory of the American Statistical Association was mailed in November. Each member of the Association receives a copy gratis. Additional copies may be purchased for $4.50 each. Orders should be sent directly to the Association at 1757 K Street, N.W., Washington 6, D. C.

Erratum: Unfortunately, one galley was printed out of alphabetical order in the letter H, between Hoc and How (pages 35-36). You may wish to make a note to this effect in your copy of the Directory.

this is designed perhaps primarily for the application of statistics to industry, the physical sciences, engineering and related technical fields, as is so often the case with statistical methods, there will be much that can be applied to other areas of interest. The first issue should appear in 1959 and quarterly thereafter.

What of actions taken " . . . to promote unity and effectiveness among all concerned . . ."? This treats not only with our relationship to other societies but with the different groups within ASA—on a geographical and sectional interest basis. The real strength of the ASA in my judgment is to be found in strong chapters. As you know, our 38 Chapters are spread from Hawaii to Puerto Rico, from Montreal to New Orleans. This tremendous range introduces both local specialization and widespread variation. A number of officers on the Board of Directors and Council have made extensive trips this year almost entirely at their own expense to present talks before many of our Chapters and regional meetings. Visits such as those made by our officers are necessary to place the central organization in closer contact with the membership. I have personally enjoyed and profited from my numerous opportunities to meet with chapters and sectional groups.

Wider participation by members on the annual and regional programs, on national and sectional committees and as officers for both the central and local organizations is definitely on the increase. However, we still find all too often that members will decline to serve when invited to do so. This is a real loss to them personally as well as to the ASA. In associations such as ours, just about all of the professional activities must be carried out with voluntary services. Francis Bacon once wrote, "I hold every man to be a debtor to his profession." By extension, we all have a responsibility to our professional societies. They represent our common interests, serve as the foci for advancing our contributions and aid in the 'cross-fertilization' of ideas from one field to another. Without your help, this would not be possible in the ASA.

Have you ever stopped to list the principal services rendered by your association? Here's a partial list:—The ASA:

1. maintains a continuing professional interest in improving statistical standards and clarifying controversial statistical issues.
2. is the center from which many important developments in statistical science arise.
3. provides forums in its annual, regional and chapter meetings where statisticians in various fields can meet and discuss their mutual problems and learn about new developments.
4. publications inform members of the basic scientific developments which will comprise the statistical science of tomorrow as well as current items of interest to the profession.
5. furthers the training and professional development of statisticians in all of its activities.
6. publishes a directory of members every three (to five) years.
7. facilitates the placement of its members through special arrangements with the United States Employment Service and by other means, including the numerous professional contacts of members.

But even this listing doesn't do full justice to our expanding accomplishments. The Association builds a year-round program based on two fundamental activities: the annual meetings and the publications. A splendid annual meeting has been planned for later this month in Chicago. You are urged to attend. Not only are there two (soon to be three) regular periodicals but additional special publications as well: Proceedings of the Business and Economic Statistics Section, the Directory, and monographs such as "Acceptance Sampling" and "Statistical Problems of the Kinsey Report". Further, there are the proposed Proceedings of the Social Statistics Section which, if approved by the Council, will be available early next year, as well as the soon to be completed Index to the JOURNAL. This latter important reference work will completely index articles and authors which have appeared in the JOURNAL OF THE AMERICAN STATISTICAL ASSOCIATION during the period 1940-1955. Copies of the Index will be ready in 1959.

This has been a year of action—of good things accomplished and suggestions of more to come; a year of hard work by so many people within the Association; and a year of growth and expansion. Throughout 1958, it has been my privilege to work in concert with all of you who have helped so much. I want to express my sincere appreciation to everyone.

I look forward with confidence to still greater accomplishments under your president-elect, Ren Likert. Most immediately, I hope to have the pleasure of seeing you at the Annual Meeting in Chicago, December 27-30, at the Congress Hotel.